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Quantum optics with surface plasmons: engineering strong coupling and efficient single-photon generation DARRICK CHANG, Harvard University, ANDERS SORENSEN, Niels Bohr Institute, PHILIP HEMMER, Texas A&M University, ARYESH MUKHERJEE, GURUDEV DUTT, MIKHAIL LUKIN, Harvard University — We propose a method that enables strong, coherent coupling between individual optical emitters and electromagnetic excitations in conducting nano-structures. The excitations are guided optical plasmons that can be localized to sub-wavelength dimensions. The sub-wavelength confinement and small mode volumes associated with these plasmons lead to strong coupling with nearby emitters. We show that under realistic conditions, this coupling causes optical emission to be almost entirely directed into the plasmon modes via a mechanism analogous to the Purcell effect in cavity quantum electrodynamics. We first illustrate this result for the case of a nanowire, before considering the optimized geometry of a nanotip. We describe an application of this technique involving efficient single-photon generation on demand, in which the plasmons are efficiently out-coupled to a dielectric waveguide. Finally, we discuss a preliminary experiment to probe and observe the strong coupling regime between a silver nanowire and quantum dot.

Darrick Chang
Harvard University

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